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ON THE DURABILITY OF CEMENT PLASTER.

By E. H. S. BAILEY and W. G. STROMQUIST, University of Kansas, Lawrence.

FORMERLY the only material used for inside plastering was lime mortar, and upon this was spread a skim coat made from plaster of Paris. Since the discovery of extensive beds of gypsite or gypsum dirt, in various localities in Texas, Indian Territory, Kansas, and Wyoming, this material has been heated to drive off nearly all of the water, and is put upon the market under the names of Agatite, Acme, Alabastine, etc., as a substitute for lime mortar. As this crude gypsum occurs in beds where it can be handled by a grader, loaded on wagons, and hauled directly to the mill, the production of this kind of plaster has become an important industry. While the ordinary gypsum rock must be ground before it can be heated in the kettles, this material needs no preliminary treatment.

The composition of the raw gypsite, the finished product and the set plaster is as follows: *

COMPONENT PARTS.	Raw.	Finished.	Set.
	%	%	%
Silica and insoluble residue.......	12.29	14.31	12.03
Iron and aluminum oxids.........	2.27	2.16	1.62
Magnesium carbonate............	.78	.91	.61
Calcium carbonate...............	8.01	9.42	8.07
Calcium oxid	2.12	1.85	1.89
Calcium sulfate...................	57.95	66.22	59.37
Water..............................	16.07	4.91	16.38
Totals..........................	99.49	99.78	99.97

From an examination of the analyses, it will be seen that the crude material loses all but about five per cent. of its water when "boiled," and when water is added to the "plaster," before spreading on the wall, it retains practically the same amount of water as it lost when heated; and in fact it again becomes gypsum, or $CaSO_4+2H_2O$.

For practical work, the mason mixes with the cement plaster from three to five parts of sand, and a little "retarder" is used to prevent the too rapid setting. This material has been used for plastering walls for the past fifteen years, and, as far as observed, it seems to last as well as lime mortar.

An opportunity to study the disintegration of this plaster under

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* University Geological Survey of Kansas, vol. V, p. 163.

peculiar conditions was recently afforded the author. In the Chemistry building at the State University, which was completed in 1900, there is a room which is plastered on the sides, and in which is situated the fan which ventilates the building. On one side this room is partially open to the air, and cold air is drawn over hot steam-pipes in the cold weather as it enters the room. The air is then drawn through the fan into the flues, by which, after passing over other steam-coils, it is distributed throughout the building. The temperature of the air in the fan room varies with that of the outside air, ranging probably in the winter from 40° F. to 72° F.

It was noticed that the plastering on both sides of the room, above a line extending from the floor on the sides nearest the pipes to the ceiling on the opposite side, had become powdery, and fallen off. In order, if possible, to find the cause of this, several analyses were made of the hard plaster which was still in place in the wall and of that which had fallen off, with the following results in one case:

Component parts.	Original plaster.	Fallen plaster.
Silica and insoluble residue	74.41%	76.42%
Iron and aluminum oxids	2.45	1.18
Magnesium carbonate	1.64	1.09
Calcium carbonate	3.09	6.18
Calcium sulfate	13.58	12.72
Water	4.75	1.98
Totals	99.92	99.57

Other samples gave:

Water	4.76%	1.57%
Water	4.56	2.05

As the samples are taken from different parts of the wall, they will not agree in composition. An inspection of the analysis, however, shows that in every case the fallen plaster contains less than half as much water as the plaster which is in place on the wall. Comparing this analysis with those previously given, we can also form some estimate of the amount of sand that is used with the original material.

It is generally conceded that the setting of plaster of Paris is due to interlacing of the small crystals of gypsum, which are formed in the moist material, and we are familiar with the fact that if all the water is driven out of the gypsum in heating, the plaster will not readily "set." It is evident, then, that about five per cent. of water is necessary to the stability of the finished wall.

The disintegration of the wall of this room may be accounted for by considering that the cold air, as it is warmed by its passage over the steam-pipes, quickly acquires a greater capacity for taking up moisture, and so it abstracts moisture from the nearest available source, namely, the plaster of the walls; this plaster having lost the water that is necessary to form the crystals of gypsum, falls to pieces just as it would before the blowpipe.

It is a well-known fact that the lime-plastered wall will fall to pieces if kept very damp for considerable time, and this is also true of walls made of cement plaster. There is no record, however, of hot, dry winds tending in any way to injure walls of this material, and it is probable that only under the special conditions mentioned above this disintegration could take place.